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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/602,395	06/22/2000	John T. Moore	MI22-1384	8705

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EXAMINER
PHAM, THANHHA S

ART UNIT	PAPER NUMBER
2813	6

DATE MAILED: 12/06/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/602,395	MOORE, JOHN T.	
	Examiner	Art Unit	
	Thanhha Pham	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 September 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-16* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-16 in Paper No. 4 is acknowledged.

2. Claims 17-28 are cancelled by Applicant.

Information Disclosure Statement

3. The information disclosure statement filed 03/26/01 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because reference of Seebarner et al [US 5,663,036] does not exist. The information disclosure statement including Seebarner et al [US 5,663,036] in the list has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1).

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With respect to claim 1,

lines 3-4 and 6, "the substrate" lacking of antecedent basis should be changed to "the semiconductor substrate"

With respect to claims 2-3, and 5-11,

"the substrate" lacking of antecedent basis should be changed to "the semiconductor substrate"

With respect to claims 4-7 and 9-10,

"the nitrogen-comprising layer" lacking of antecedent basis should be better changed to "the nitrogen-containing layer"

With respect to claim 12,

lines 3-4, 6 and 9, "the substrate" lacking of antecedent basis should be changed to "the semiconductor substrate"

line 9, it is not clear that "the at least of the substrate" is actually which part of the substrate/semiconductor substrate. *Recommend*: *"the at least of the substrate" should be better changed to "the at least some of the semiconductor substrate that is not covered by the first oxide region"*

With respect to claim 13-16,

"the substrate" lacking of antecedent basis should be changed to "the semiconductor substrate"

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

5. Claims 1-3, as being best understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Soleimani et al [US 5,596,218] submitted in IDS.

Soleimani et al, figs 1-6 and col 1-5, discloses the claimed method of forming an oxide region over a semiconductor substrate comprising steps:

forming a nitrogen-containing layer (22, fig 4) across at least some of the semiconductor substrate; and

after forming the nitrogen-containing layer , growing an oxide region from the at least some portions of surface of the semiconductor substrate, the nitrogen of the nitrogen-containing layer being dispersed within the oxide region (see fig 5)

6. Claims 1-3, as being best undetstood, are rejected under 35 U.S.C. 102(b) as being anticipated by Soleimani et al [US 5,330,920].

Soleimani et al, figs 1-3 and col 1-3, discloses the claimed method of forming an oxide region over a semiconductor substrate comprising steps:

forming a nitrogen-containing layer (22, fig 4) across at least some of the semiconductor substrate by plasma niridation ultilizing nitrogen species generated in a plasma that is at least about 4 inches from the semiconductor substrate for about 0-30 seconds at a temperature of about 0-400oC; and

after forming the nitrogen-containing layer, growing an oxide region from the at least some portions of surface of the semiconductor substrate, the nitrogen of the nitrogen-containing layer being dispersed within the oxide region (fig 6, col 3)

7. Claims 1-4 and 9-11, being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Okumo et al [US 6,110,842].

Okumo et al, figs 1-4 and col 1-5, discloses the claimed method of forming an oxide region over a semiconductor substrate comprising steps:

forming a nitrogen-containing layer (fig 1B) across at least some of the semiconductor substrate by plasma niridation ultilizing nitrogen species generated in a plasma that is at least about 4 inches from the semiconductor substrate for about 0-30 seconds at a temperature of about 0-400oC; and

after forming the nitrogen-containing layer , growing an oxide region from the at least some portions of surface of the semiconductor substrate, the nitrogen of the nitrogen-containing layer being dispersed within the oxide region (see fig 1C)

8. Claims 1-4, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Shue et al [US 6,197,701].

Shue et al, figs 1-8 and col 1-10, discloses the claimed method of forming an oxide region over a semiconductor substrate comprising steps:

forming a nitrogen-containing layer (14, fig 2) across at least some of the semiconductor substrate by plasma activated nitrogen species; and

after forming the nitrogen-containing layer, growing an oxide region from the at least some portions of surface of the semiconductor substrate, the nitrogen of the nitrogen-containing layer being dispersed within the oxide region (see fig 3)

9. Claims 1-3 and 12-14, as being best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Ghidini et al [US 6,114,203].

Ghidini et al, figs 1-2 col 2-3, discloses a method of forming a pair oxide regions over a semiconductor substrate comprising steps of:

forming an oxide layer (24, fig 1) over a covered region of the semiconductor substrate and an uncovered region of the semiconductor substrate by exposing the semiconductor substrate in oxidizing conditions;

removing the oxide layer from over the uncovered region of the semiconductor substrate thereby forming a first oxide region wherein the first oxide region defined by the oxide layer covering the covered region of the semiconductor substrate;

forming a nitrogen-comprising layer across at least some of the first oxide region and across at least some of the semiconductor substrate that is not covered by the first oxide region;

[see col 3 lines 3-13]

after forming the nitrogen-containing layer, growing a second oxide region from the at least some of the semiconductor substrate that is not covered by the first oxide region.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 5-8, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Okumo et al [US 6,110,842] as applied in claim 1 above in a further view of DeBusk et al [US 6,140,187].

Okumo et al substantially discloses the claimed method except teaching a usage of a remote plasma nitridation for forming the nitrogen-containing layer. Okumo et al also teaches forming the nitrogen-containing layer by plasma nitridation when the semiconductor substrate is biased or is not biased relative to the plasma.

DeBusk et al teaches that using the remote plasma nitridation is a good method for forming the nitrogen-containing layer with a better control nitrogen amount in the nitrogen-containing layer without damaging underlying layer.

It would have been obvious for those skilled in the art to combine the teaching DeBusk et al to use the remote plasma nitridation in the process of Okumo et al wherein nitrogen species generated in a plasma at least about 12 inches from the semiconductor substrate and the semiconductor substrate not being biased relative to the plasma during formation of the nitrogen-containing layer.

Moreover, with respect to claims 5-8, range of distance of plasma source to the semiconductor substrate and ranges of time and temperature for forming the nitrogen-containing layer are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious.

> "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller 105 USPQ233, 255 (CCPA). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, one of ordinary skill in the requisite art at the time of invention was made would have used any suitable ranges of distance, time or temperature to optimize the process of Okumoto et al in view of DeBuck et al.

11. Claims 5-11, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Shue et al [US 6,197,701] in view of Okumo et al [US 6,110,842] and DeBusk et al [US 6,140,187].

Shue et al substantially discloses the claimed method except of specific details of claimed parameters for plasma nitridation including range of distance of plasma source to the semiconductor substrate, ranges of time and temperature for forming the nitrogen-containing layer by plasma nitridation and a usage of remote plasma nitridation. Regarding using the remote plasma nitridation, forming the nitrogen-containing layer by the remote plasma nitridation is a well-known technique to form the layer with a better control nitrogen concentration without damaging underlying layer (see DeBusk et al as an evidence). Regarding the range of plasma source to the semiconductor substrate and ranges of time and temparature for forming the nitrogen-containing layer, the such claimed ranges are considered to are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art (see Okumo et al discloses the claimed range parameters or the range parameter which is close to the claimed range). As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious. See *In re Aller 105 USPQ233, 255 (CCPA). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).* See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996), claimed ranges of a result effective variable which do not overlap the prior art ranges are unpatentable unless they produce a new and unexpected

result which is different in kind and not merely in degree from the value of results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA), discovery of optimum value of result effective variable in known process is ordinary within skill of art.

12. Claims 2-11 and 15-16, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Ghidini et al [US 6,114,203] in view of DeBusk et al [US 6,140,187] and Okumo et al [US 6,110,842].

Ghinidi et al substantially discloses the claimed method except of specific details of claimed parameters for nitridation including range of distance of plasma source to the semiconductor substrate, ranges of time and temperature for forming the nitrogen-comprising layer by plasma nitridation and a usage of remote plasma nitridation. Regarding using the remote plasma nitridation, forming the nitrogen-comprising layer by the remote plasma nitridation is a well-known technique to form the layer with a better control nitrogen concentration without damaging underlying layer (see DeBusk et al as an evidence). Regarding the range of plasma source to the semiconductor substrate and ranges of time and temparature for forming the nitrogen-comprising layer, the such claimed ranges are considered to are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art (see Okumo et al discloses the claimed range parameters or the range parameter which is close to the claimed range). As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious. See *In re Aller 105 USPQ233, 255 (CCPA). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25*

USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934). See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996), claimed ranges of a result effective variable which do not overlap the prior art ranges are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the value of results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA), discovery of optimum value of result effective variable in known process is ordinary within skill of art.

13. Claims 1-4 and 12-14, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa [US 6,091,109] in view of Shue et al [US 6, 197,701].

Hasegawa, figs 1-7's and col 1-12, discloses a method of forming a pair oxide regions over a semiconductor substrate comprising steps of:

forming an oxide layer (19, fig 1A) over a covered region (B) of the semiconductor substrate and an uncovered region (A) of the semiconductor substrate;

removing the oxide layer from over the uncovered region (A, fig 1B) of the semiconductor substrate thereby forming a first oxide region wherein the first oxide region defined by the oxide layer covering the covered region of the semiconductor substrate;

growing a second oxide region from the at least some of the semiconductor substrate that is not covered by the first oxide region.

Hasegawa does not teach forming a nitrogen-comprising layer across at least some of the first oxide region and across at least some of the semiconductor substrate that is not covered by the first oxide region before growing the second oxide region.

Shue et al teaches forming the nitrogen-comprising layer over a silicon substrate or silicon oxide layer would provide a better oxide layer with an enhanced hot carrier resistance

and dopant diffusion barrier properties and a great uniformity dielectric in a subsequent step of growing dielectric oxide layer by oxidation.

It would have been obvious for those skilled in the art to combine the teaching of Shue et al to forming the nitrogen-comprising layer across at least some of the first oxide region and across at least some of the semiconductor substrate that is not covered by the first oxide region in the process of Hasegawa before growing the second oxide region. By doing so, the second oxide region will be formed with great uniformity, enhanced hot carrier resistance and dopant diffusion barrier properties to improve performance of a semiconductor device.

With respect to claim 14, Examiner takes Official Notice that forming the oxide by exposing the substrate to oxidizing conditions is very well-known in the art.

14. Claims 5-11 and 15-16, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa and Shue et al as applied to claims 1 or 12 above, and further in view of DeBusk et al [US 6,140,187] and Okumo et al [US 6,110,842].

Hasegawa in view of Shue et al substantially discloses the claimed method except of specific details of claimed parameters for plasma nitridation including range of distance of plasma source to the semiconductor substrate, ranges of time and temperature for forming the nitrogen-containing layer by plasma nitridation and a usage of remote plasma nitridation. Regarding using the remote plasma nitridation, forming the nitrogen-containing layer by the remote plasma nitridation is a well-known technique to form the layer with a better control nitrogen concentration without damaging underlying layer (see DeBusk et al as an evidence). Regarding the range of plasma source to the semiconductor substrate and ranges of time and temparature for forming the nitrogen-containing layer, the such claimed ranges are considered

to are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art (see Okumo et al discloses the claimed range parameters or the range parameter which is close to the claimed range). As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious. See *In re Aller 105 USPQ233, 255 (CCPA). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).* See also In re Huang, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996), claimed ranges of a result effective variable which do not overlap the prior art ranges are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the value of results of the prior art). See also In re Boesch, 205 USPQ 215 (CCPA), discovery of optimum value of result effective variable in known process is ordinary within skill of art.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bowers Charles can be reached on (703) 308-2417. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham
November 30, 2001

Charles Bowers
Supervisory Patent Examiner
Technology Center 2800